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NOTES AND EXTRACTS.

METEOROLOGY OF THE PLANET MARS.

Many generations of astronomers have been interested in studying the appearances of the various planets as seen through the best telescopes. Most of the planets appear to have gaseous atmospheres analogous to that of the earth, and meteorological phenomena have been observed on their surfaces that are described as clouds, storms, snow fields, etc. In the case of the moon, there are even brilliant points that shine like the reflection from ice. If we could get nearer to these distant celestial bodies we might hope to study the meteorology of their atmospheres as we do that of the earth, for they undoubtedly receive their heat from the sun and are subject to annual and diurnal periods. As it is, however, the best results at present give us only a very imperfect idea of what is going on in their atmospheres. Professors E. C. and W. H. Pickering, of Harvard University, with the help of a magnificent series of photographs of the moon, have demonstrated the probability that here and there on its surface there issue jets of some heavy vapor like carbonic acid gas (since aqueous vapor is too light to stay there), and that this vapor forms white frost-like deposits in shady regions until dissipated by the sun's heat.

Mr. Lowell, of the Flagstaff Observatory, has made an elaborate study of the planet Mars, confirming much that had been done by Schiaparelli, of Milan, and adding some observations and some theories to our previous knowledge. He finds the changes from summer to winter not only well pronounced but varying very much from year to year, just as occurs in our own atmosphere. The melting of the great fields of "snow" around the planet's polar regions, as each Martian winter closes and spring comes on, gives rise to great streams of water (we call it water in the absence of any evidence as to the specific nature of the fluid), and as these streams flow toward the equator a band of green, like grass or foliage, spreads out on both sides so that we seem justified in concluding that the atmosphere and the vegetation as well as the climate of Mars have some analogy with our own. It is, however, very strange that we find no appearance of clouds on that planet, as though it were possible for water, snow, irrigation, and vegetation to exist without clouds or rain. Of course vapor could diffuse from a region of water to one of snow, but not vice versa. We must still study to find out whether this occurs on Mars.

Owing to the inclination of the axis of rotation of Mars and the location of his equinoctial points, his midwinters do not occur at the same time as our own: Thus, a recent report from the Flagstaff Observatory states that the first layer of winter snow (or possibly winter frost work) was observed on Friday, May 19, 1905, and covered a vast area in the northern or arctic region of the planet.

It is quite possible that the atmosphere of Mars has much less of the dry gases, such as oxygen and nitrogen, and relatively more moisture, so that its general circulation is based on small differences of vapor pressure. Consequently the transfer of moisture from its poles to its equator and back again takes place in a gentle way, more like diffusion through a vacuum than like convection by a gas; so that there are fewer cyclonic storms, perhaps none at all.

MR. HARRY B. WREN.

Mr. Harry Bertrand Wren, Observer, Weather Bureau, died October 1, 1905, at Paola, Kans., of a pulmonary affection. Mr. Wren entered the Weather Bureau in June, 1898, and served at Denver, Cheyenne, Baltimore, and the Central Office. He was a graduate of Baker University, Baldwin, Kans., from which institution he received the degrees of Ph. B. and M. A. Mr. Wren was a man of high character and attainments and of a pleasing disposition; he gave excellent service as an observer in the Weather Bureau.—*H. E. W.*

EIFFEL'S "ETUDES PRATIQUES."

The eminent engineer, Monsieur G. Eiffel, of Paris, to whom we owe the Eiffel tower and its unique meteorological observatory in midair a thousand feet above the ground, has published a very elegant volume of studies based on observations at three stations established by himself, in order to investigate three special types of climate in France. These stations are Beaulieu-sur-Mer representing the climate of Nice; the chateau of Bruyères representing the climate of Sévres, near Paris; and finally, a station on his estate, Vacquey, representing the climate of Bordeaux. These three stations, he says, should give us a general idea of three important portions of France, viz, the southern shore of France known as the "Côte-d'Azur", and the oceanic coast in the neighborhood of Bordeaux, and the climate of Paris, which latter may serve as a common standard of comparison for the other two. At each of these points Eiffel established a thermometer shelter of the model adopted by the Central Meteorological Bureau of France, which allows of the freest possible circulation of the air while protecting from the direct rays of the sun and direct radiation into space.

He first calls attention to the fact that ordinary self-registering thermometers show such rapid oscillations in temperature every few minutes during the whole day that the thermometers in ordinary meteorological use can not follow them accurately, nor is it desirable that they should, that in fact the climatologist wants only the average warming and cooling of the air, and that the mixture of hot and cold masses in the atmosphere must render illusory any attempt to determine the temperature of the air at any moment to the tenth of a degree centigrade. The mean temperature of the day can be obtained from thermometers so sluggish that they are always two or three tenths behind. Nothing is easier than to read a thermometer to the tenth of a degree, but there is no reason to attach much importance to these tenths except in the cases where the difference of two adjacent thermometers is desired, as in using the whirled psychrometer, or where we are determining vertical or horizontal gradients of temperature.[1] On the other hand, the continuous registers, with all their oscillations, show what a very imperfect idea we get of the atmospheric temperature when we have only three readings a day. Notwithstanding the imperfections of the thermographs due to the nature of the liquid employed and the friction within the apparatus, and notwithstanding the fact that they

[1] It is by observing the tenths of divisions that astronomers, physicists, chemists, and meteorologists have been stimulated to greater precision in all their work, and have attained a better knowledge of nature.

are looked upon with suspicion by those who seek the greatest but illusory precision—Eiffel states that he would urge their general employment, that is to say, self-registers should be used for every class of current observations, and their records should be considered as a means of reducing to a minimum the labor and the chance of error that attend personal observations. He adds that in his opinion the self-registers should be regulated not according to the legal hour but according to local solar time since the sun is the source of all meteorological phenomena. This adoption of the local hour seems to him essential because there can exist a difference of three-fourths of an hour between different points in France so that the temperature at sunrise at Nice should be compared with that of sunrise at Brest and not with that taken three fourths of an hour before sunrise; from a climatological point of view observations taken simultaneously on legal time can not be comparable with each other. But the error introduced by adopting several fixed hours for daily observation does not trouble us when we study the amplitudes of any phenomenon. The graphic presentation of daily maxima and minima is usually made by means of an upper and a lower curve between which there is included an area showing the diurnal range of temperature during the different portions of the year. These curves are singularly interesting and become the foundation of many studies of comparative climatology.

In such studies, moreover, Eiffel prefers the meteorological year, December to November, inclusive, rather than the civil year recommended by each International Meteorological Congress and used almost universally by meteorologists. He states that he regrets thus to differ from others, but thinks it impossible to admit any other grouping of the months. He also subdivides each month into three decades, namely, two groups of ten days each followed by one of eight, nine, ten, or eleven days according to the month. He thinks this is better than fifty-two weekly groups, but says nothing about the comparative convenience of the pentads and decades introduced by Dove which are now widely used both in and out of France. We can but think that the points urged by Eiffel as to local time and decades are less important to the world at large than the uniformity urged by the successive international conventions. We doubt very much if anything is gained from a climatological point of view by conservatively declining to give up these irregular subdivisions of the month, and the so-called local mean solar time. The diurnal periods of temperature, wind, pressure, etc., are controlled by apparent noon and apparent time, not by mean solar time.[2]

On the other hand we have been greatly pleased to find that Eiffel has supplemented the whirling psychrometer by an earnest attempt to make comparative observations with Edelmann's psychrometer, which really gives us a direct measurement of the elastic force or vapor pressure at any time or place, although often not more accurate than given by the formula for the whirling psychrometer. The reader will find the Edelmann instrument, its construction, theory, and method of use, fully described in the Zeitschrift für Meteorologie, Vol. XIV, 1879, as well as in the Editor's Treatise on Meteorological Apparatus and Methods. The ordinary formulæ and tables for use with the whirled psychrometer require the preliminary determination of one or two numerical constants; this has ordinarily been done by means of comparative observations with the dew-point apparatus and the vapor pressure given by Regnault's or some equivalent tables of vapor pressure for saturated vapor. But the Edelmann apparatus enables us to avoid this circuitous process and determine the vapor pressure directly. The only doubt is as to whether his method and apparatus can compare in accuracy with the results of the years of labor that have been given to improving the psychrometer and its formula.

With reference to hygrometry in general, Eiffel introduces a system of terms that seems to him to better represent the ideas that we wish to convey. He would replace the expressions "relative humidity, or hygrometric state, or fraction of saturation," by the term "hygrometric ratio" as expressing simply the percentage of saturation. Again he would replace the words "absolute humidity, or elastic force, or vapor tension" by the single word "humidity," meaning thereby the weight in grams of the aqueous vapor contained in a cubic meter of air. He presents on page 66 a diagram or "hygrometric abacus" for obtaining graphically the value of the hygrometric ratio when the humidity and temperature are known. We do not quite see that this graphic table is any easier to use or even as easy as the ordinary numerical table, but there are special problems bearing on the condition of the atmosphere in which it will doubtless be of great use.

An interesting note at the bottom of page 68 quite agrees with observations frequently made elsewhere, viz, that saturated air is almost never to be found. Even in the midst of a fog the air is rarely saturated. The mean of the observed maximum tensions corresponding to the two temperatures of two masses of air that mix together and form fog is always greater than the maximum tension corresponding to the mean of the temperatures. The heat given out by the precipitation of the vapor as fog first warms the air above this mean temperature, and so long as this heat is not lost by radiation or conduction the fog is lifted and the air warmed so that its temperature would seem to be too high to correspond to the observed maximum tension.

On page 76 we find a representation of the psychrometrograph with aspiration, as constructed by W. Lambrecht at Göttingen. Eiffel reports that this apparatus performs very satisfactorily. The wet thermometer is a minimum thermometer, which therefore registers the lowest temperature attained during the aspiration, and care must be taken to supply its muslin covering with an abundance of water. He notes that even this arrangement, however, like all other forms of psychrometer, can not be recommended for use at temperatures below freezing, in which cases the hair hygrometer alone can be relied upon and is in fact, he says, in general use in meteorological observatories. As the hair hygrometer is rarely used in America, we ought, perhaps, to quote the conclusions arrived at in 1901 by Pircher, at Vienna, which substantiate the views held by Pernter and with which Eiffel seems to agree. They are as follows:

1. The readings of the hair hygrometer are independent of temperature.

2. They never vary more than four per cent from the true relative humidity, and even a ventilated psychrometer will not have smaller departures from the truth.

3. A nonventilated psychrometer has much larger errors than the hair hygrometer.

4. The readings of the hair hygrometer are independent of the velocity of the wind.

It results from all this that the hair hygrometer is at least as correct as the ventilated psychrometer. It is, moreover, easier to read and its employment is to be recommended, provided we take the necessary precautions as to its standardization by frequently adjusting the 100-degree point under a bell glass containing saturated air.

[2] Apparent noon, or the moment when the center of the true sun is on the meridian, occurs about fourteen and one-half minutes after mean noon in February, about four minutes before noon in May, six minutes after at the end of July and sixteen minutes before mean noon about the first of November. Or again when a correct mean time clock says mean noon in February the sun is fourteen and one-half minutes of time east of the meridian; in May it is four minutes west; in July six minutes east; and in November sixteen minutes west of the meridian. These oscillations between +14 and —16 minutes are quite comparable with the changes introduced by using the mean time of some standard meridian, and must be allowed for in all refinements as to insolation and temperature.

Having settled these details, Eiffel established several forms of hygrometer and carried out comparative observations, from which he concludes that the Lambrecht polymeter and thermohygroscope as well as Lambrecht's weather telegraph with rules based on the observed temperature, pressure, moisture, and wind, give prognostics that are generally exact. American observers in a much drier climate have not reported so favorably.

The remaining chapters of this volume are devoted to the rain, clearness of the sky, the wind, and the barometer, followed by appendices giving tabular summaries of the observations from 1879 to 1903. A separate volume of diagrams and charts accompanies the text.

METHODS OF TEACHING METEOROLOGY.

Numerous requests are received from those giving limited courses of instruction, both Weather Bureau officials and nonofficial teachers, asking for sets of lantern slides to illustrate lectures; card indexes to current literature; and various publications bearing on meteorology with the idea that all these will help to keep the instructor informed as to the latest discoveries and will also enable him to give popular public lectures.

It seems to the Editor that the instruction in meteorology given in most of our schools and colleges needs to be of a fundamental, solid, character, and not of the popular superficial character appropriate to lectures that are illustrated by lantern slides. The study of the subject as expounded in the textbooks of Davis, Waldo, Ward, Hann, and others implies considerable intense thought. Laboratory experiments will often be very useful in elucidating the subjects of moisture, rainbows, halos, waterspouts and tornadoes; carefully drawn charts elucidate hurricanes; actual work with thermometers and perhaps with kites will interest every student in the distribution of temperature in the atmosphere; but a lecture with stereopticon illustrations should only come in as a sort of luxury once or twice during the course. It is really not at all essential. It is especially important for the teacher himself to be so interested in his subject as to devise his own diagrams and apparatus, at least some of them. Almost anyone can make a crude nephoscope out of a bit of mirror, or the cover of a tin pail turned over and filled with water. It is not necessary to buy a $50 barometer in order to explain or observe the variations of atmospheric pressure. It is only after one has taught in his own original way for several years that he begins to realize the power of his own ingenuity and finds that he is doing better with crude material than many another man is doing with an elaborate equipment. If the educational apparatus that he devises is copied, manufactured, and sold to other teachers by some enterprising, money-making firm, that simply proves that some are intellectually sluggish and do not push their own school work on the independent, original basis that he himself does. There is no reason why the Weather Bureau officials should not take the lead in devising the best methods of teaching meteorology and climatology.

THE RAINFALL OF MEXICO.

The Annals of the Association of Engineers and Architects of Mexico has published in its twelfth volume, among many other interesting papers on engineering, one by Romulo Escobar, on the "Regimen of the Rainfall of Mexico." He gives in detail all accessible special items relative to the measurements of rainfall for a large number of stations. What particularly interests us is the comparative table from which we have made the following abstract showing the average rainfall for each successive lustrum. In place of taking an indiscriminate average of many years at one station and a few years at another we are able now to compare the simultaneous rainfalls at different places, and indeed if there were only stations enough, or if Mexico had not such a very irregular orography, one might be able to reduce the whole system of measurements to one uniform fundamental period of standard lustra, such as, for instance, as 1881–1900, inclusive. Among his general conclusions, Escobar calls attention to the fact that most stations show a steady diminution for a long period of years, but that this has already begun to be followed by an increase. A similar diminution has been observed in our Gulf States from Texas to Alabama and Tennessee, but perhaps the subsequent increase that may be expected has not been everywhere observed owing to the frequent changes in our rain gages and their exposures.

Average annual rainfall, by lustra, with number of years of record. Amounts in millimeters.

Stations.	Before 1877.	1877–1881.	1882–1886.	1887–1891.	1892–1896.	1897–1901.
Hacienda el Carmen						5 684.8
Querétaro		5 623.8	5 518.3	5 486.4	5 386.1	5 430.8
Zapotlán					3 805.0	5 977.5
Linares					1 796.0	5 844.6
Aguascalientes		1 418.4	5 607.1	1 542.2		
Guanajuato		1 893.5	5 818.9	5 721.7	5 526.5	4 680.0
Jalapa					3 1334.3	4 1657.9
Morelia			1 648.8		3 661.5	5 703.7
Oaxaca		3 715.3	4 716.7	5 943.5	5 804.9	2 862.2
Tepic	19 1433.7		2 2301.7	5 1435.1	3 1334.3	
San Luis Potosi		4 403.9	5 365.2	5 426.2	5 284.6	4 303.8
Huejutla			5 1175.1	3 1538.1		
Pabellón		5 515.6	5 499.9	4 581.6		
Tacubaya			3 585.0	5 773.4	5 533.8	4 660.5
Real del Monte				3 873.0	5 606.1	4 835.3
Teziutlán		3 1716.8	2 1251.9	1 2268.2		
Túxpan		2 1549.0	3 1197.1	3 1584.7		
Merida				2 887.5	5 801.9	5 924.5
Monterey			2 422.2	5 335.2	5 398.2	5 712.9
Mazatlán		2 1201.4	5 842·7	5 758.7	5 669.2	5 794.4
Colima		4 1045.5		1 1233.0	5 821.0	4 1000.9
Pachuca					4 293.9	5 2254.4
Puebla, Col. Católico		5 1144.9	5 1258.2	5 1373.1	5 988.4	5 893.3
Puebla, Col. del Estado		4 963.4	5 860.3	5 969.4	5 821.5	5 810.9
México	15 671.3	5 566.2	5 589.0	5 651.4	5 471.1	5 577.9
Toluca			2 678.0		5 671.7	5 681.0
León		4 691.5	5 745.1	5 743.2	5 504.0	5 565.9
Saltillo			5 500.0	5 597.7	5 641.9	5 441.5
Guadalajara	3 810.3	5 941.5	5 829.9	5 992.0	5 1487.5	4 1493.1
Zacatecas		4 655.5	5 898.2	5 811.6	5 302.0	5 593.6
Galveston, Tex		4 1219.5	5 1269.6	4 1159.1	5 830.4	4 1159.9
El Paso, Tex		3 331.6	5 278.7	4 164.2	5 205.3	4 214.7
Yuma, Ariz		4 50.1	5 91.7	1 90.2	5 68.8	4 50.3

TEMPERATURES ON MOUNT ROSE, NEV.

Prof. J. E. Church of the University of Nevada at Reno, Nev., has made an effort to obtain a record of temperatures on the summit of Mount Rose, whose elevation is approximately 10,800 feet, latitude 39° 20′ north, longitude 119° 55′ west. Maximum and minimum thermometers were established in a small thermometer shelter at the summit toward the end of June and will be visited and reset as often as practicable. The record for the first three months is as follows: